WATER OPERATION AND MAINTENANCE

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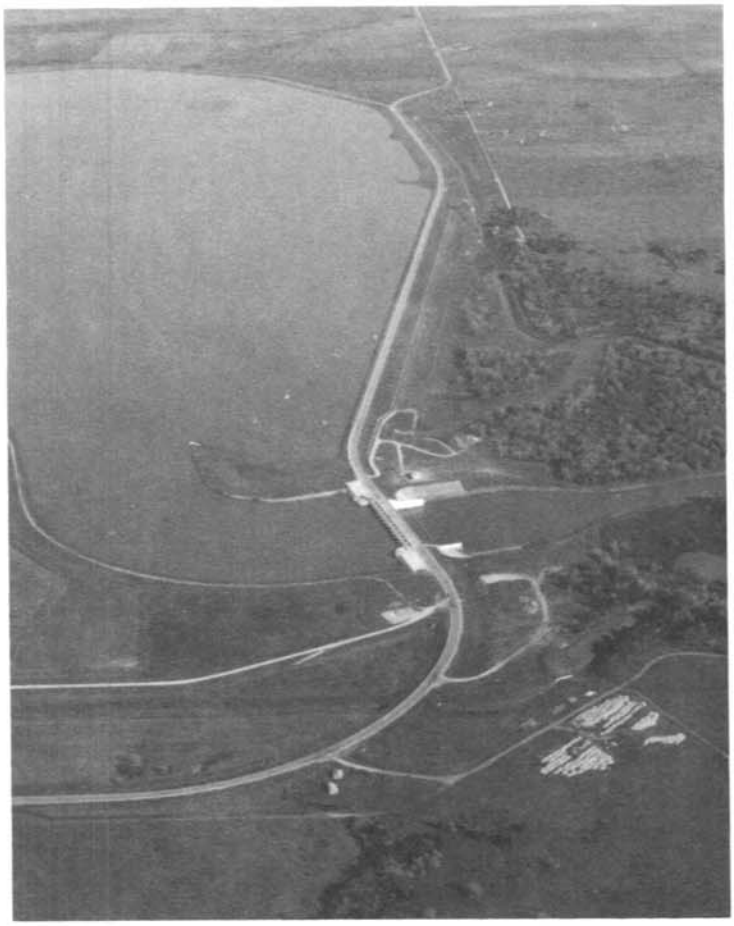
September 1988



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UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

The Water Operation and Maintenance Bulletin is published quarterly for the benefit of those operating water supply systems. Its principal purpose is to serve as a medium of exchanging information for use by Bureau personnel and water user groups for operating and maintaining project facilities.

While every attempt is made to insure high quality and accurate information, Reclamation cannot warrant nor be responsible for the use or misuse of information that is furnished in this bulletin.

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Facilities Engineering Branch
Engineering Division
Denver Office, Code D-5210
PO Box 25007, Denver CO 80225
Telephone: (303) 236-8087 (FTS 776-8087)

Cover photograph:

Palmetto Bend Dam, Texas

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

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PESTICIDE EXPOSURE: KNOW THE SYMPTOMS[1]

By Becky Ohlde, Field Editor

What do the flu and pesticide poisoning or exposure have in common? Their signs and symptoms.

What you might experience from pesticide poisoning or exposure can be similar to what you would experience from other illnesses. According to Larry Schulze, University of Nebraska extension specialist in pesticide training, you should be aware of two kinds of clues to pesticide poisoning: Signs and symptoms.

"Signs are recognizable by someone else," Schulze says. "Vomiting is a sign. Symptoms are feelings that only the person who has been poisoned recognizes - such as nausea or a headache."

With Schulze's help, we prepared a chart of five of the most common chemical families associated with herbicides. For each chemical family, we have described the action of the poison on the human system; some signs and symptoms of internal exposure, external exposure, and chronic (repeated) exposure; and a couple of trade names for each chemical family as examples.

In our Crop Guide Issue on insects later this winter, we will list the same type of information on a chart for insecticides and fungicides.

Herbicide exposure systems

CHEMICAL FAMILY	ACTION ON HUMAN SYSTEM	INTERNAL EXPOSURE	EXTERNAL EXPOSURE	CHRONIC EXPOSURE	TRADE-NAME EXAMPLES
Chlorophenoxy	Irritant to lung, stomach and intestinal linings. Injure liver, kidney and nervous system	Prompt vomiting, burning sensation in stomach, diarrhea, muscle twitching	Moderately irritating to eyes, skin and lungs	Do not remain in body; passed from body within hours or days	Banvel (dicamba) 2, 4-D
Acetamides	Irritants	None	Moderately irritating to skin and eyes	None	Dual (metolachlor) Bicep (metolachlor —atrazine)
Acetanilides	Irritants	None	Mild irritants; propachlor is a skin irritant and sensitizer	None	Lasso (alachlor) Ramrod (propachlor)
Thiocarbamates and Dithiocarbamates	Low human toxicity	Nausea, vomiting, diarrhea, weakness and nasal stuffiness	Irritating to skin, eyes, nose and throat	None	Sutan (butylate) Eradicane (EPTC)
Triazines	Irritants	None	Mildly irritating to skin, eyes, nose and throat	None	Sencor Lexone (metribuzin) AAtrex (atrazine) Bladex (cyanazine)

SIGNS AND SYMPTOMS. This chart lists the signs and symptoms of internal, external and chronic (repeated) exposure to five of the most common chemical families used in herbicides. We have also included a couple of trade names as examples of products for each family of chemicals. Their inclusion implies neither less nor greater risk than other products that could have been listed as examples.

[1] Reprinted with permission from the Editor of the Nebraska Farmer, February 20, 1988, issue.

When you or any of your coworkers experience flu-like signs or symptoms while handling pesticides, get medical attention as quickly as possible in case you have pesticide poisoning, Schulze says.

Schulze stresses that pesticide labels are the quickest and first source of first aid information for pesticide poisoning.

"First, read the first aid instructions on the pesticide label," Schulze says. "Follow those instructions. If you are alone with a victim of pesticide poisoning, make sure the victim is breathing and is not being further exposed to the chemical before you call for emergency help. Be careful so you are not also exposed to the pesticide."

Whenever possible, find out what pesticides were used and how the exposure occurred. Schulze also says to take the pesticide label with you to the physician's office.

"Doing so will allow the physician to know what chemicals are involved in the accident, particularly if the farmer is unable, because of the accident, to tell the physician what was involved," he explains.

There are treatments for certain types of pesticide exposure that can "buy time" for the victim and stop further injury by the pesticide. However, these treatments are not meant to take the place of proper medical attention from a physician.

POISON ON THE SKIN: Act quickly. Remove contaminated clothing and drench the victim's skin with water. Cleanse skin and hair thoroughly with detergent and water. Dry victim and wrap in blanket.

CHEMICAL BURN ON SKIN: Wash with large quantities of running water. Remove contaminated clothing. Cover burned area immediately with loose, clean, soft cloth. Do not apply ointments, greases, powders, or other drugs.

POISON IN EYE: Wash eye quickly, but gently. Hold eyelid open and wash with gentle stream of clean running water. Wash for 15 minutes or more. Do not use chemicals or drugs in the wash water because they may increase the extent of injury.

INHALED POISON: Carry the victim to fresh air immediately. Open all doors and windows so no one else will be poisoned. Loosen tight clothing. Apply artificial respiration if breathing has stopped or if the victim's skin is blue. If the victim is in an enclosed area, do not enter without proper protective clothing and equipment. If proper protective equipment is not available, call for emergency equipment from your fire department.

POISON IN MOUTH OR SWALLOWED: Rinse mouth with plenty of water. Give victim large amounts of milk or water to drink (up to 1 quart). Induce vomiting only if instructions to do so are on the label.

"Many labels direct that vomiting be induced," Schulze says. "Vomiting can be induced by giving the victim ipecac and water, or by inserting the finger into the throat of the victim."

However, do not induce vomiting when the pesticide label says not to; when convulsions have occurred; if the victim is unconscious; if the victim has swallowed a pesticide containing petroleum products; or if the victim has swallowed a corrosive pesticide.

Schulze also recommends that, for the sake of time, family members — or whoever else finds a victim of pesticide exposure — drive the victim to the doctor's office instead of waiting for an ambulance.

THESE PESTICIDE PHONE NUMBERS MAY SAVE LIVES:

The following telephone numbers may save your life someday. Keep them readily accessible in your home or workshop when pesticides are being handled.

They are emergency and informational numbers to use in case of pesticide poisonings or other types of accidents regarding exposure to pesticides.

The **Chemical Transportation Emergency Center (CHEMTREC)** provides an emergency number to call in case of pesticide accidents. The number, **1-800-424-9300**, is for emergency use only.

For non-emergency health and safety information regarding practically any chemical, you can call **1-800-262-8200** Monday through Friday, from 7 a.m. until 8 p.m. At this number, sponsored by the Chemical Manufacturers Association, you can get answers to questions on product, chemistry, toxicity, and disposal.

Another non-emergency information number is the **National Pesticide Telecommunications Network, 1-800-858-7378**. You can obtain information from pesticide specialists on pesticide poisoning, disposal, training, ingredients, labeling, and regulations.

(NEBRASKA RESIDENTS).–The most useful number may be the **Mid-Plains Poison Control Center,** a part of Children's Memorial Hospital, Omaha. That toll-free number is **1-800-642-9999**. You can call that number 24 hours a day, 7 days a week.

Consult your local telephone directory for the nearest Poison Control Center in your area and keep this number by your telephone.

THE EYES HAVE IT[1]

by James Lahey

Injuries to the eyes and face need
not be as frequent as they used to be
because the variety of eye and face
protection available provides the
right cover for any risk.

AND IT ALL STARTS AT THE TOP — WITH THE CEO.

Full protection for the face and eyes is still a goal.

Although efforts, through standards, started after World War II, injuries to the eyes and face still take their toll. There are no figures for face injuries, but damage to the eyes alone account for 5 percent of all injuries and 1 percent of all compensation.

Industry leaders work hard to keep up with changing technology and problems. At presstime, the most recent ANSI standard available was *Practice for Occupational and Educational Eye and Face Protection*, Z87.1-1979. In 1980, the ANSI committee that put out this standard met again to update it. Draft VI, dated August 1987, was being reviewed prior to promulgation.

The stated goal of the proposed revision is to "emphasize performance standards" and to "accommodate advancements in design, materials, technologies, and product performance."

The group also worked from a study by the Bureau of Labor Statistics indicating that most eye injuries to people wearing protection happened because the device did not provide enough coverage from the sides. The committee then changed testing to include impact protection from the side.

The proposed standard covers both eye and face because some protectors guard the eyes only while others cover both eyes and face.

The new Z87.1 classifies eye and face protectors as spectacles, faceshields, goggles, welding helmets, and special purpose lenses.

As could be expected, each classification is further broken down into subclassifications. These subcategories are complete and thorough, too much so to be reported in depth here.

But Z87.1 also lays down guidelines for protector selection. It lives up to its advertising - the guidelines are based on performance, rather than specific parameters.

First, the standard reemphasizes OSHA's basic philosophy (Z87.1 is an ANSI standard, but will, most likely, become an OSHA requirement):

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[1] Reprinted from Safety & Health, January 1988, a publication of the National Safety Council.

"* * * eye and face protective devices are not substitutes for machine guards, engineering controls, and sound manufacturing practices. Personal eye and face protective devices alone should not be relied on to provide protection against hazards, but should be used in conjunction with guards, engineering controls, and sound management practices."

In protector selection, the standard emphasizes matching the protective equipment to the hazard:

"The person directly responsible for a safety program should apply common sense and fundamental technical principles to accomplish these tasks. This process is subjective by nature, because of the infinite variety of situations where face and eye protection may be required."

Optical radiation comes from electric arc welding, gas welding, cutting, torch brazing, torch soldering, and glare. Electric arc welding calls for hand-held, stationary window, or lift front welding helmets. Z87 calls for a typical filter lens shade of from 1 to 14. The standard points out that optical radiation protection is related to the density of the filter lens. Select the darkest shade compatible with adequate vision. Gas welding demands the protection of several types of goggles and faceshields, as do cutting and torch brazing operations. Lens filters recommended for gas welding are 4 through 8; for cutting, 3 through 6; and torch brazing, 3 and 4. Torch soldering demands spectacles or welding faceshields with lens filters from 1.5 through 3. The standard also notes that faceshields must be worn over primary eye protection. Glare can be cut down with the use of spectacles either shaded or special purpose, as needed.

The NSPB (National Society to Prevent Blindness), Schaumburg, Illinois, has additional recommendations for specific eye and face protection. These guidelines include:

Cable jumping and servicing of batteries - chemical goggles are suggested for protection against acid splashing and explosions.

Electrical contact, arcing, and sparks need protective devices with nonmetallic frames.

Spray painting, coating, and related operations produce sprays, splashing, and spilling - they need safety spectacles with sideshields or chemical goggles and, for severe exposures, goggles plus faceshields.

Another area not covered by Z87.1 is protection against laser beams.

But the National Safety Council's *Accident Prevention Manual for Industrial Operations*, Ninth Edition, says that no single type of glass or plastic can protect against all laser wavelengths. So most companies do not depend on personal protective equipment alone. Some firms think that goggles or spectacles give a false sense of security.

But eye protection is still needed and is available for almost all lasers. The proper type for the hazard can be specially ordered from manufacturers. When dealing with protection from lasers, it is particularly important to work closely with suppliers.

Safety professionals should know some of the characteristics of laser protective filters. They are quite different than other eye protection.

Protective goggles that are suitable in the laboratory will often fog up in the field. A lens designed for one type of laser may be dangerous if used to protect against a laser with a different wavelength.

In addition, lens exposed to intense energy or power density levels may lose effectiveness rather quickly. They should be discarded.

For in-depth discussions of laser characteristics, see the Council's *Fundamentals of Industrial Hygiene*, Third Edition, and *The Safe Use of Lasers*, ANSI Z136.1-1986.

As mentioned earlier, Z87.1 will change the impact test routine to allow for testing for hits from the sides. The head form is hit successively as it is rotated, so that the devices are hit from angles of 0° to 90°.

The use of contact lenses with eye protection has become a factor.

It started many years ago with a rumor that welding flashes would fuse the lens to the eyeball. The rumor was later expanded to include electric flashes of other kinds. The rumor has never been proved true. Nevertheless, a safety professional who is faced with this rumor should call a manufacturer, an optometrist, the National Safety Council, or the NSPB for current information.

This just means that there is no pat answer to the right protection for the job. The safety professional must depend upon his knowledge of the job and individuals involved, his training and experience, and professional safety expertise.

The safety pro is going to have to juggle various factors, including:

What the most recent Z87 Selection Chart contains.

What protective devices are available and what they can protect against, such as splashes, impact, and radiation.

The matchup between the equipment and the degree of hazard, such as nature of the substance being splashed, impact velocities, and radiation intensities.

The protection must be more than a match for the hazard.

Proper fit of the equipment.

Instructions on care and use that stress warning labels and contents.

Reasonable ease of care, maintenance, and repair.

On some jobs, 100 percent eye protection must be specified and the rule enforced.

Faceshields should not be used alone but with eye protection such as goggles or spectacles.

Eye protection is available in current fashion styles.

Federal and local requirements for protection must be met or bettered.

The new Z87.1 also provides guidance on picking the right protection for the job. It categorizes the guidelines by hazard: impact, heat, chemicals, dust, and optical radiation.

Impact comes from operations like chipping, grinding, machining, etc., and produces flying fragments of various sizes. Recommended protective devices are spectacles, goggles, and faceshields. But they must provide protection on the sides and not use filters or tinted lenses that cut down the light that reaches the eye. Such lenses can restrict vision and should not be used unless there is a glare hazard.

Heat hazards come from furnace operations, pouring, casting, hot dipping, gas cutting, and welding. These operations produce hot sparks, molten metal splashes, and high temperatures. Various types of goggles and spectacles, with sideshields, are recommended. Severe exposures would call for faceshields. When worn over goggles, faceshields should be used where molten metal is handled. Exposure to high temperatures can be handled with screen or reflective faceshields. The standard notes that spectacles along with cup and cover goggles do not provide enough protection and that protectors without sideshields will not do it.

Chemical exposures include acid and chemicals handling, degreasing, plating, etc. The hazards of such operations are splashes and irritating mists, according to the standard. Protection against splashes is available from cover and cup goggles and, in severe exposures, faceshields. Z87.1 specifies that ventilation of the devices should be adequate, but not allow entry of the splash. Protection not recommended includes spectacles, welding helmets, and handshields.

Dust is the result of woodworking, plastic working, buffing, and generally dusty conditions. These operations result in nuisance dust in the work area, the standard says. Protection in this area calls for eyecup and cover goggles. Frequent cleaning of the eye pieces will probably be necessary because of the atmospheric conditions and poor ventilation of the goggles.

The use of contact lenses has grown and most likely will continue to do so. The NSPB estimates that some 2 million Americans are fitted with contacts every year. Further, some 12 to 15 million already wear them.

Current data indicate that wearers of contact lenses are as well protected as others in the workplace if they wear eye protection.

The NSPB gives the following recommendations about wearing contact lenses on the job:

"Occupational safety eyewear meeting or exceeding ANSI Z87.1 standards should be worn at all times by individuals in designated areas.

"Employees and visitors should be advised of defined areas where contacts are allowed.

"At work stations where contacts are allowed, the type of eye protection required should be specified.

"A specific written management policy on contact lens should be developed with employee consultation and involvement.

"Restrictions on contact lens wear do not apply to usual office or secretarial employees.

"A directory should be developed that lists all employees who wear contacts. This list should be maintained in the plant medical facility for easy access to trained first aid personnel. Foremen or supervisors should be informed of individual employees wearing contact lenses.

"Medical and first aid personnel should be trained in the proper procedures and equipment for removing all types of contacts from both conscious and unconscious workers.

"Employees should be required to keep a spare pair of contacts and/or a pair of up-to-date prescription spectacles in their possession. This action will allow the employees to perform their job functions, should they damage or lose a lens while working.

"Employees who wear contact lenses should be instructed to remove contacts immediately if redness of the eye, blurring of vision, or pain * * * associated with contact lens use occurs."

In an effort to place the question in proper perspective, the NSPB has issued the following position statement on wearing contacts on the job:

"Contact lenses may be worn in many occupations. Contact lenses provide an adequate means of visual rehabilitation for employees who have had a cataract removed from one or both eyes; who are highly nearsighted; who have irregular astigmatism from corneal scars or keratoconus. However, when the work environment entails exposure to chemical fumes, vapors, or splashes; intense heat; molten metals; highly particulate atmospheres, contact lens use should be restricted. Certain federal or state regulations may also limit their use.

"Contact lenses, of themselves, do not provide eye protection in the industrial sense. For occupational use, contact lenses should be worn only in conjunction with appropriate industrial eye protection. The employer should ensure the identification of the contact lens wearer for appropriate emergency care and for protection in work areas hazardous to the eyes."

Phototropic (photochromic) lenses are another high tech development that Z87 addresses. They darken when exposed to sunlight and fade when removed from sunlight. The standard points out that they are used for comfort in many kinds of light.

It recommends that they be used with care. Because they change slowly, they should be used with care when sharp acuity is necessary or where the user moves in and out of the plant as part of the job. It gives a forklift driver as an example for the latter type job.

Care should be used when the wearer drives vehicles at night. The driver will be exposed to rapidly changing light levels and the depth-of-tint changes in the lens will fall behind.

Many would not allow their use for night driving at all. As a general rule, they should not be worn indoors where illumination levels tend to be barely adequate.

Z87.1 takes a stronger stand on one aspect of photochromic lenses:

> "Although photochromic lenses absorb ultra-violet light, they shall not be used as a substitute for the proper protector in hazardous optical radiation environments."

Perfect eye and face protection is not here yet and technological developments keep changing the picture. But manufacturers and standard writers are working very hard to provide support.

But at the bottom line, it is up to the safety and health professional to provide the best and the latest.

FLAX-STRAW AND ROCK DROPS[1]

Using Nature's Own Material to Harness Her

In 1980, the Bow River Irrigation District, in conjunction with UMA Engineering Ltd., began experimenting with rocks and flax-straw to see if they could come up with a design for a low-cost drop structure. This type of structure was not proposed for use in channels continuously running water but more for periodic drainage works. Of immediate concern at the time were Drains No.64 and 81. These channels were eroding badly and had steep sides causing cattlemen concern for their cattle that must cross and water in the drains.

Figure 1. - Erosion occurring prior to installation of the rock drops.

The proposed rehabilitation was submitted to Irrigation Council and approved in May of 1980. However, Council noted that although they had approved the use of these types of structures, the project was experimental in nature and that followup inspections and evaluations were to be made.

Jack Ganesh, P.Eng., Section Head of Evaluation and Management in Alberta Agriculture, is monitoring the sites on a yearly basis since their construction in 1982-83. He files this report prepared after his 1987 fall inspection and has included some background for our readers.

[1] Reprinted with permission from the Editor from the Water Hauler's Bulletin, Volume 30, Winter/88 issue. Published by the Alberta Agriculture Center, Lethbridge, Alberta, Canada.

"The flax-straw drops installed in the drain were constructed as follows: Flax-straw bales were stacked in a manner to form a chute with a depressed bowl for a stilling basin. Over the bales, black poly filter x was laid (poly filter x is a perforated polyethylene membrane). The poly filter x and flax-straw bales were held in place with welded wire mesh and one metre long steel pins driven in the ground between bales. Sometime after the original construction, large rocks (100 to 600 mm) (4 to 24 inches) were placed on top of the wire.

"In my 1987 inspection, with representatives from both the District and UMA, we found that all the flax-straw had rotted away and vanished. The filter x, steel pins, wire mesh, and rocks were still in place. A luxuriant growth of grass was present where once the straw had been. The membrane filter and the rocks have continued to provide protection to the earth below. The erosion will remain in check as long as the poly filter is present to stop the soil from washing out.

"Originally five rock drops were installed in 1982 in Drain No. 64 Hays. Of these, two were vertical drops, made by containing rocks in a vertical shape by use of steel posts and welded wire mesh. These two vertical drops kept on washing out the earth at the abutments until the shape of the drops were changed. The vertical 'sill' was depressed in the centre to allow all the flow to go down the centre. With the water not reaching the abutments now, it has not washed them out. The chute drops have worked very well.

Figure 2. - Rock drop in Drain No. 64 Hays has stopped erosion - excellent regrowth of vegetation occurring.

"After the first 2 years, all five structures started to show a buildup of silt upstream. However, they were too far apart to allow for a more uniform distribution of this material. The District then installed four more intermediate chute shaped rock drops.

"Our 1987 inspection revealed that all nine structures are functioning well and that a considerable buildup of silt has occurred. Vegetation is starting to grow back. This is a complete reversal of the process that was occurring in the coulee prior to the installation of the rock drops."

Ganesh says he expects the rock drops to hold up but has some reservations about the remaining poly filter x material in the flax-straw structures if additional rock is not imported and placed soon.

If these lower cost structures will continue to perform efficiently with little maintenance, after all, isn't this what leading-edge irrigation technology is all about.

For more information, please contact Mr. Jack Ganesh, P.Eng., Project Planning Branch, Alberta Agriculture, Agriculture Centre, Lethbridge, Alberta, T1J 4C7 [telephone (403) 381-5164].

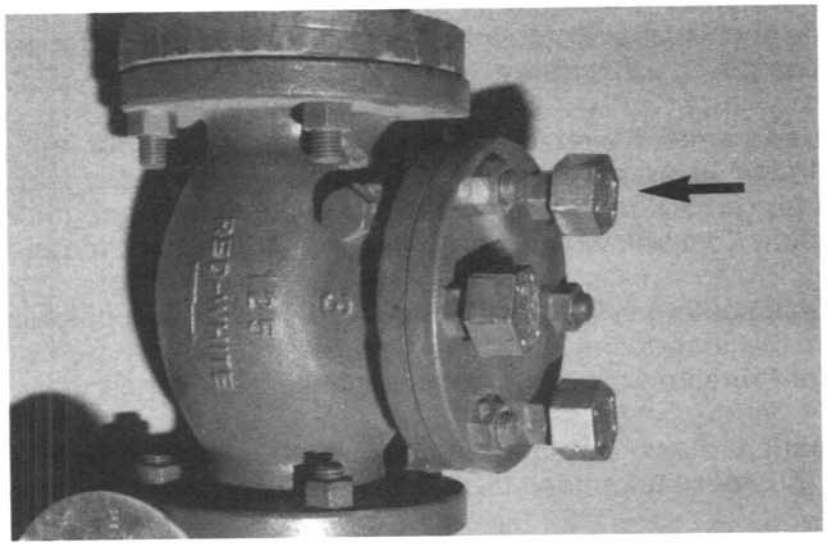
CAP IT - BURY IT - FORGET IT[1]

New Method of Providing Cathodic Protection to Buried Steel Fittings

Of utmost interest to an irrigation district is the protection of their buried steel fittings from corrosion. The most obvious economic contribution to good maintenance is to keep all susceptible fittings fully protected.

A new unique method of providing protection (Protecto Caps) was recently evaluated by the Department of Chemical Engineering and Applied Chemistry at the University of Toronto. What are Protecto Caps? Protecto Caps are zinc alloy nut-like anodes which are wrenched on the threaded ends of the external bolts of the fitting. By firmly attaching Protecto Caps, studies showed the nuts, bolts, and the adjacent flanges of the buried fittings were assured long-term protection from galvanic corrosion.

What degree of protection from corrosion do these Protecto Caps provide? The answer to this question depends on several factors. Number one being soil resistivity. Some soils are much more corrosive than others; therefore, the degree of protection provided by the zinc anode caps varies accordingly. Second, the size of the fitting being protected is a factor. For example, a large fitting with only two caps on it would only be protected for a short period of time as the anode cap would be destroyed by galvanic action quite quickly. Although increasing the number of zinc caps placed on a fitting would not necessarily increase the degree of protection conferred to the steel, increasing the number of caps does greatly increase the length of time it is protected.



Protecto Caps attached to fitting.

[1] Reprinted with permission from the Editor from the Water Hauler's Bulletin, Volume 30, Winter/88 issue. Published by the Alberta Agriculture Center, Lethbridge, Alberta, Canada.

Third, the coating of the fitting itself is also a factor in determining whether additional corrosion protection is required and how much. If the fitting is initially galvanized or epoxy coated, then maybe only the nuts and bolts are subjected to corrosion and need protection. Very often the bolts holding the fittings together are the first to fail; and in this case, the Protecto Caps would assure long-term protection against corrosion.

Tests and information resulting from research done by the International Lead/Zinc Institute show the life expectancy of 90 gram Protecto Caps installed on a buried 150 mm ductile iron 90° bend with average coating can be determined as follows:

Soil resistivity (Ohm-cm)	2 caps (years)	6 caps (years)	12 caps (years)
1000 (corrosive)	5	20	35
2000	7	30	50
3000	10	40	65
4000	12	55	90
5000	16	70	110
6000	20	85	140
7000 (passive)	25	95	165

From the above statistics it is noted that even in the most corrosive soils, protection can be significantly prolonged just by adding more anodes to the buried fittings.

Protecto Caps may also be used on fittings that are submerged in a corrosive environment such as water with a high salt content. All of the tests, by the University of Toronto, were done by immersing the fittings in a salt solution for up to 1,100 hours. It was shown that the zinc anode caps conferred excellent cathodic protection to iron mechanical joint fittings and gland ring assemblies.

What about costs and sizes available? Protecto Caps are available in sizes ranging from 11 mm to 19 mm in the 90-gram weight and 23 mm to 26 mm in weights up to 400 grams. Approximate cost for the 90-gram anode is $2.00 each, and a similar size in a 180-gram weight is $2.50 each. Cost will vary according to size and weight requested.

Even the most stable coating system for fittings will suffer some deterioration with time. This should, from the standpoint of economics and maintenance, be considered, and maybe a number of Protecto Caps be installed as cheap insurance.

For further information, please contact Mr. Grant Hunter, 1708 - 31 Street SW., Calgary, Alberta, T3C 1N1 [business telephone (403) 240-2100 or residence telephone (403) 246-4341].

METRIC
25.4 mm = 1 inch
28 grams = 1 ounce

OPERATIONS ORIENTED CANAL SIMULATION MODEL

By David L. King[1] and Francis Gichuki[2]

Introduction

Canal simulation models have been used for a number of years for research and design. These models typically used large computers, had esoteric application, and were usually non-user-friendly. More recently, models have been written for or converted to a PC (personal computer). Reclamation has converted the GSM (gate stroking model) to a PC. The input and output of GSM have been improved, but the model runs slowly on a PC, does not model branching systems, and does not lend itself to operational use.

Utah State University has developed a PC canal simulation model called CANSM which is very user-friendly, runs fairly fast, and models branching systems. The prototype of the model was useful as a design aid and educational tool. Reclamation has contracted with the author of the model (Mr. Gichuki) to modify the model so it can be used as an operational tool. Modifications included adding steady state startup, use of files for entering demand data, and additional options. Figure 1 is a typical entry screen, and figure 2 is the main output screen.

CANSM was developed as part of a research component of the Main Systems Design and Management and Rehabilitation Special Study Topic under the U.S. Agency for International Development, Water Management Synthesis II Project. This work is an extension of surface irrigation modeling which treated overland flow in furrows, basins, and borders.

The model is intended to be used as a framework to formulate guidelines for the selection and development of appropriate technology for the operation of the main canal system. In applying the model to study water conveyance and distribution problems, structural, operational, social, legal, economic, and organizational constraints can be evaluated. Initially, the model will generate a wide range of technically feasible solutions considering only structural, hydrologic, and hydraulic constraints. Out of these technically feasible solutions, an interdisciplinary team can identify socially, financially, operationally, and organizationally acceptable solutions for the improvements of water conveyance and distribution.

The model will need to be supported by proper recordkeeping, proper maintenance of the system, accurate determination of the model inputs and a reliable working force. Occasional calibration to verify the model and gain insight in main system operation should also be conducted.

Summary of the Model

A user manual is available to aid in learning the use of CANSM. The model is based on solving the integrated form of Saint Venant's equations which describe steady and

[1] David L. King is a General Engineer employed by the Bureau of Reclamation, Denver, Colorado.
[2] Francis Gichuki is a post-doctorate fellow, Department of Agricultural and Irrigation Engineering, Utah State University, Logan, Utah.

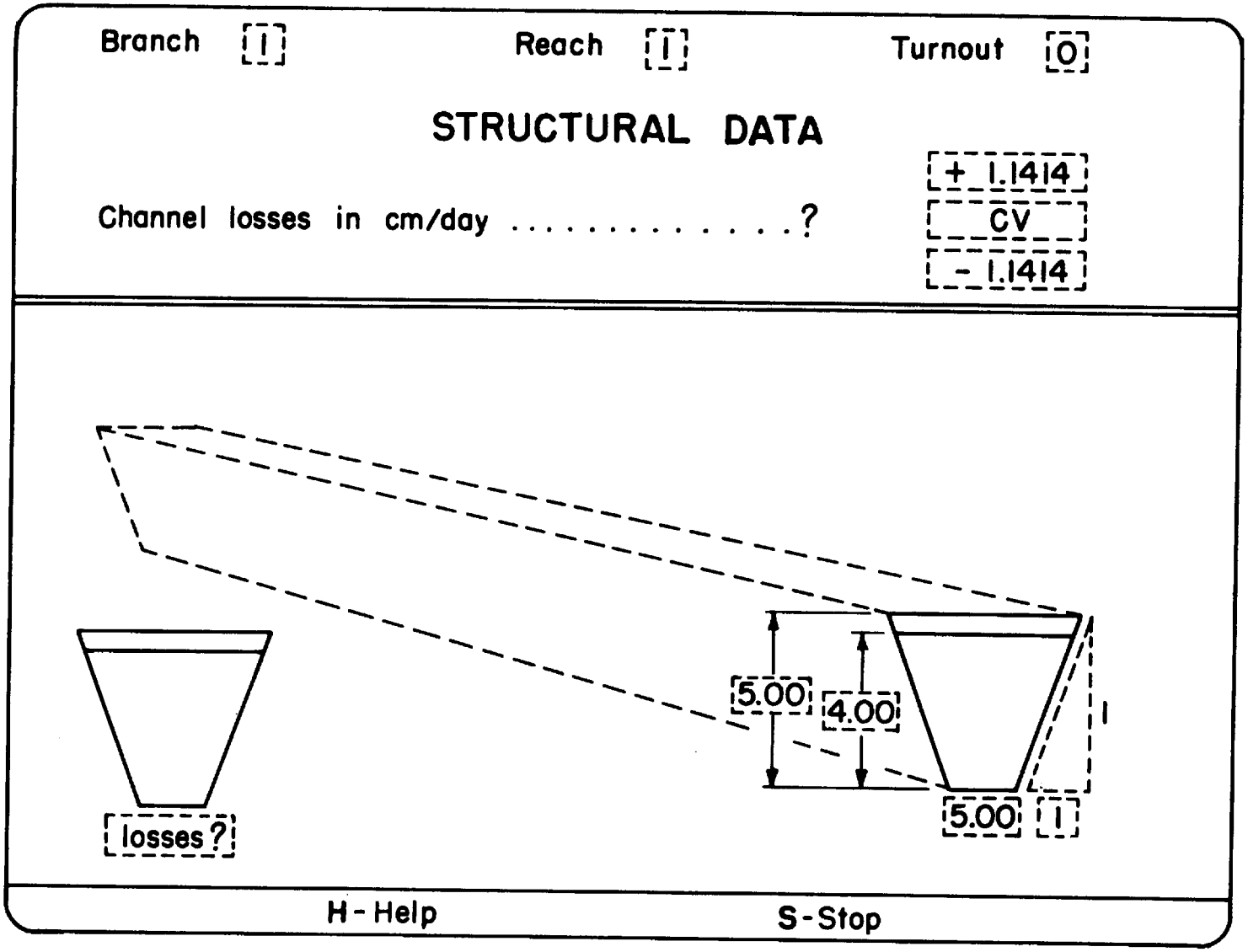


Figure 1. Typical Data Entry Screen

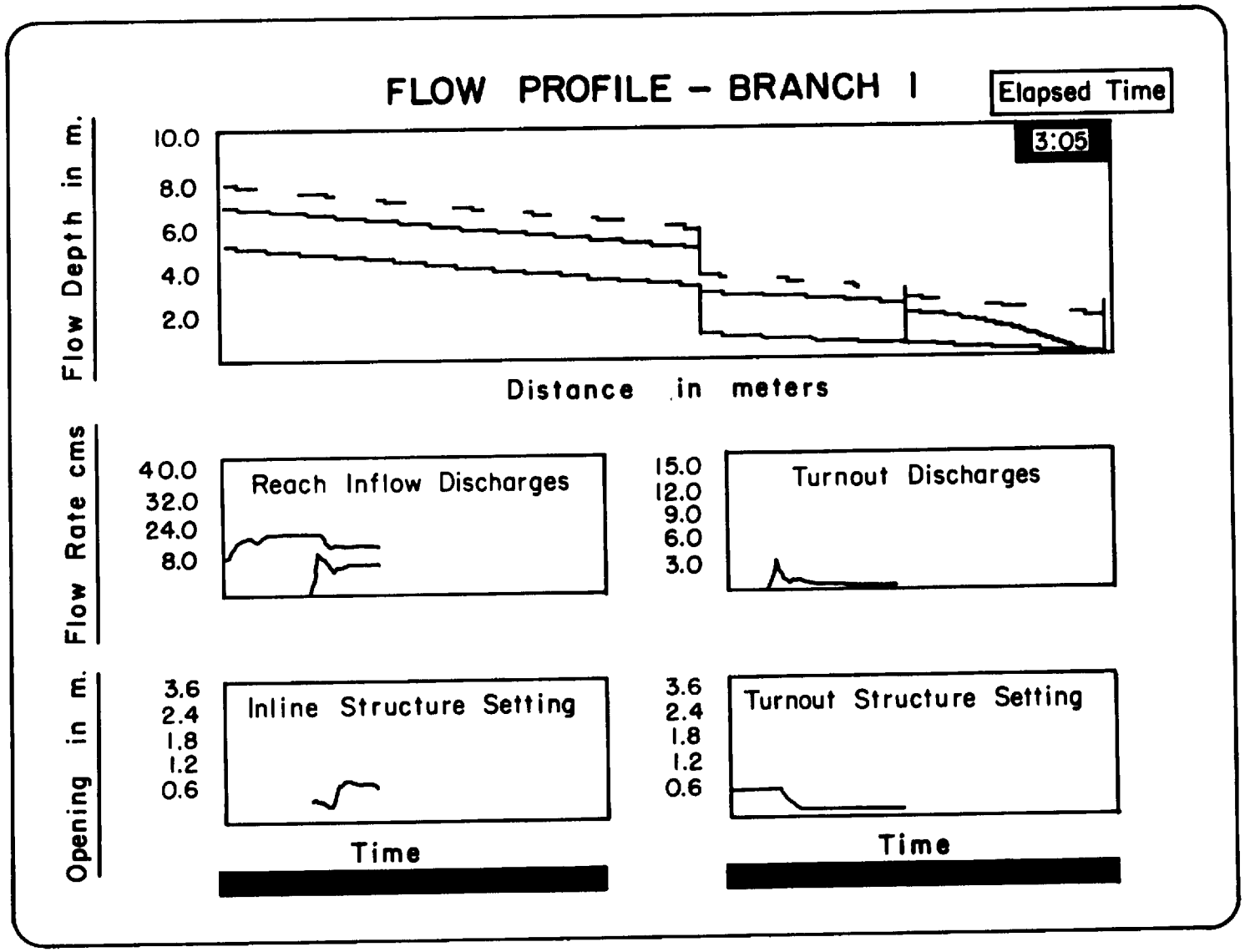


Figure 2. Canal Simulation Output Screen

unsteady, uniform and nonuniform flow. The model simulates canal filling, operating, and draining phases, bulk lateral outflow or inflow into the section, and control structure scheduling (gate stroking). The model has three water control options:

1. Operator decision control in which the model user decides which inflows and control structure settings should be implemented

2. Program-generated system inflow and control structure settings which achieve predetermined upstream flow depths

3. Program-generated system inflow and control structure settings which deliver a specified discharge to the lower reach

The program is menu driven and includes built-in "help" explanations that can be called at any point in the simulation process. It traps data entry errors and has a graphical display of input and simulation status. Interactive simulation is provided to enable the user to pause the simulation, critically examine the simulation status, and make necessary changes of operational data.

Before applying the model, it has to be calibrated for the project. After the model has been calibrated for a particular system, the system operators can use it as an operational aid. It provides amateurs and professionals with a tool to address issues related to the interaction between the design and operation of the canal network as one pursues a more dynamic operation of the system. Also, an interdisciplinary planning team can use the model to answer many "*what if* . . . .?" questions on operational alternatives and obtain answers in a relatively short time.

For example:

Can the operational performance be improved by adding more control structures and/or using different types of structures?

How will the system perform under different water-scheduling criteria and scenarios?

How will poor maintenance affect the operation of the system?

Designs can be given operational testing to identify bottlenecks and compare configurations, structures, and operating rules. This computer simulation model will, therefore, allow planners and designers to evaluate the operational performance of their plans before they are finally implemented. Due to the model's enhanced user interface, graphical displays, interactive simulation, and flexibility, it will provide a useful tool for training new system operators.

CANSM provides the user with sufficient flexibility in the application of the algorithm to simulate the physical and operational characteristics of an irrigation conveyance and distribution system. The mathematical model can be used to determine flow rates and flow depths at all points in the canal network that result from a given physical structure and operational scenario.

Its basic output is the water level and flow rate throughout the sections of the network that are being modeled. Depending on the mode of operation, the model will also generate the inflow hydrograph and control structure settings required to achieve a predetermined conveyance and distribution objective. The computations are made at 5-minute intervals and the frequency of output display is user selectible.

If the reader desires to learn more about canal hydraulics and operations, you may reference "Operation of Canal Systems" by D. C. Rogers. Contact the Water Conveyance Branch, Civil Engineering Division, Denver Office of the Bureau of Reclamation.

Uses

The model can be used for operation and maintenance, design, and planning issues. Some of the specific uses of the model include:

1. Operation and Maintenance

   a. Simulate filling and emptying of a branching canal network with multiple inlets. This can be used to verify the routing of water allocations.

   b. Determine the optimal control structure setting required to route the water effectively.

   c. Determine the effect of the unused irrigation demand on the canal hydraulics and the appropriate control structure setting to minimize the spills.

   d. Determine the optimal inflow hydrograph given the irrigated area's demands.

2. Design

   a. Investigate the effect of different control structures on canal hydraulics.

   b. Determine the optimal type, number, and location of control structures.

   c. Investigate the need for intermediate reservoirs, their location, and capacity in order to reduce the spills and reduce system lag time.

   d. Subject the conveyance and distribution system design to various operating scenarios to identify operational bottlenecks before the system is constructed.

3. Planning and Evaluations

   a. Determine the hydraulic response (time lag, backwater, and seepage) due to maintenance issues like siltation and weeds.

   b. Evaluate the performance of an existing system to determine the need for rehabilitation.

   c. Used with other irrigation system models (Watershed, Reservoir, Water Allocation, and Unit Command Area), it can evaluate the overall system performance and optimization of the resources (land, water, labor, energy, etc.).

4. Training

a. The model will have a significant contribution in training operations staff on how to best operate and manage the system.

b. The model will be useful for training designers of canals.

Conclusions

A canal simulation model has been developed which can be used to aid in making decisions when operating a canal. The model is very user-friendly, provides color graphics, and runs quickly on a PC. A non-graphics version is available for those users without color monitors. A 286, or newer generation, PC is recommended with 640K of memory. The model may be obtained from the Facilities Engineering Branch, Engineering Division, Denver Office, Bureau of Reclamation or from Utah State University, Department of Agricultural and Irrigation Engineering.

NEW MACHINE MAY SOLVE PESTICIDE DISPOSAL[1]

By Darrell Smith

A new machine may help farmers and chemical retailers dispose of herbicide wastes without danger.

Developed at USDA's Agricultural Research Service Laboratory in Beltsville, Maryland, the device uses two 55-gallon drums, one with ozone and one containing micro-organisms. During testing, it successfully broke down the herbicides atrazine, Lasso, Treflan, Sencor/ Lexone, and Basagran and one insecticide, Co-Ral, into harmless compounds that easily decompose in the environment, says chemist Philip Kearney.

In the two-step degradation process, ozone in the first barrel breaks down chemical bonding of the pesticide. Then micro-organisms in the sand and soil in the second drum continue the process. The water is collected in a pit for the final stages of degradation.

The machine cost $8,000 to build. It could solve a dilemma for pesticide applicators and many farmers: What to do with leftover pesticides and rinseate. "The problem is greater for retailers than for farmers, but the same principles apply," says A. G. Taylor, agricultural adviser to the Illinois Environmental Protection Agency.

"Operators of one retail outlet for years had pumped all their waste to an area along a railroad right-of-way," says University of Illinois entomologist Allan Felsot, who is investigating ways to decontaminate soil. "The area looked like a bomb had hit it."

Felsot is applying the contaminated soil over farm fields - in effect reducing the concentration - to see if soil micro-organisms can decompose it. "The technique may be practical under some circumstances," he says. "But we have found that when you contaminate an area with chemicals over a long period, changes take place and the chemicals do not degrade as rapidly as they do when applied normally to a crop."

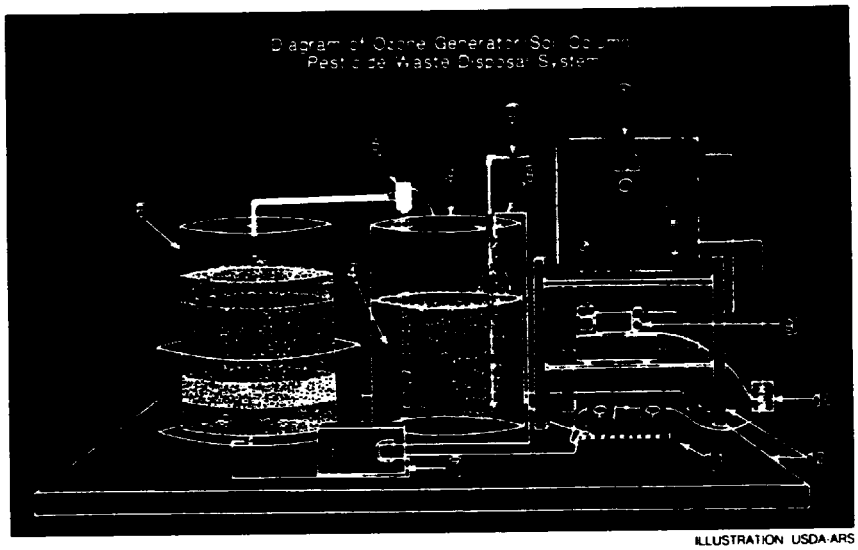


ILLUSTRATION USDA-ARS

THIS PROTOTYPE UNIT CAN reduce pesticides into easily broken down components. Unit parts: 1=ozone generator; 2=dispersion tube; 3=ozone chamber; 4=waste solution; 5=transfer pump; 6=soil column; 7=recycling pump; 8=return line; 9=air pump; 10=electrical source; 11=electrical strip with timers; 12=wood frame.

[1] Reprinted with permission from the Editor of the Farm Journal, Mid-January 1988 issue.

Such contamination is less likely on a farm because small amounts of pesticides and leftover rinseate can be applied to fields. But similar contamination could occur if a sprayer was rinsed frequently enough at the same location, says Felsot. "Try not to allow concentrations of chemicals to build up in one place," he advises.

"The same principle applies if you accidentally spill chemicals," says Felsot. "Spread the contaminated soil over a field. That gives micro-organisms a better chance to decompose it. Of course, do not rinse an applicator near a well where rinseate may find its way to ground water."

THERE'S NO EASY WAY TO DISPOSE OF CHEMICALS[1]

by Darrell Smith

Accumulation of farm chemicals in the soil around rinsing sites is just one potential danger posed by pesticides. A hazardous waste cleanup day last summer in Champaign County, Illinois, indicated that there is a large volume of hazardous compounds sitting around houses and machine sheds.

City and rural residents dropped off 25,000 pounds of hazardous waste ranging from bags of old farm pesticides to cans of flea spray to more than 3 tons of DDT, a banned insecticide. "One 55-gallon drum was three-quarters full of DDT," says David Thomas, director of the Illinois Hazardous Waste Research and Information Center. "Another 1,800 pounds, brought in by a bank, was found lying in broken bags in a shed after a farm had reverted to the lender."

Of special concern, says Thomas, was the fact that 43 vehicles showed up hauling banned herbicides which contained dioxin, or PCB.

Those loads were turned away. "There is no facility in the state licensed to destroy PCB's," says Thomas.

Any kind of hazardous waste disposal is likely to be an expensive proposition. "One contractor estimated it would cost $2,000 to go to a farm and pick up a couple quarts of DDT for disposal," says A. G. Taylor of the Illinois EPA (Environmental Protection Ageny). "If he could piggyback that job with something else in the same area, he might be able to do it for $600.

The cost is high because disposal firms are usually located in remote areas - an example of the "not in my backyard" syndrome among homeowners, who do not want such firms in their neighborhood, says Taylor.

"If you have only small quantities of hazardous compounds, your best bet right now is to store them in a secure container and hope a collection drive is held in your locality," says Taylor. "I expect to see more such collection drives. For large quantities, your state EPA may be able to help you locate a disposal firm."

[1] Reprinted with permission from the Editor of the Farm Journal, Mid-January 1988 issue.

SPOTLIGHT ON PALMETTO BEND PROJECT

Texas

Palmetto Bend Project is a multipurpose water resource project developed primarily to provide a dependable M&I (municipal and industrial) water supply to the Coastal Plains area of Texas. Palmetto Bend Dam stretches across the Navidad River about 4 miles upstream from the confluence of the Lavaca and Navidad Rivers. The reservoir, Lake Texana, includes an 18-mile reach of the Navidad River Valley and the lower portions of Mustang Creek and Sandy Creek Valleys.

The Coastal Plains of Texas spread inland from the Gulf Coast ranging from sea level to an elevation of about 300 feet. These flat, fertile lands are well adapted to farming and cattle ranching. The area surrounding the Lavaca and Navidad River Basins was one of the first areas settled in Texas and has been principally an agricultural area. The agricultural segment of the economy suffered from excessive rainfall during planting and harvesting seasons over the years as well as from the effects of Hurricane Carla in 1961.

A local bond issue authorized participation in the Palmetto Bend Project in 1967, and the Congress of the United States subsequently approved construction in 1968. Ground was broken for Palmetto Bend Dam in 1976 and the first water was impounded in 1980. The availability of water from the Palmetto Bend Project promotes urban and industrial growth in the area.

Palmetto Bend Dam is unique because its proximity to the Gulf of Mexico places it in a hurricane belt and makes it subject to high tidewater. Specially covered slopes of the dam and extra steel anchors in the concrete spillway are a few of the protective measures against wave action. Flood control capacity was not provided because of topographic limitations of the site. The dam, constructed across the Navidad River Valley about 7 miles southeast of Edna, Texas, is a rolled earthfill structure with a separate concrete spillway. The total length of the dikes and dam is about 8 miles, with the main embankment section across the river valley being 1.3 miles. The top of embankment is at elevation 55 with a top width of 42 feet. The height of the dam above streambed is 63 feet.

With water at elevation 44, Lake Texana extends about 18 miles up the Navidad River Valley and backs up Mustang Creek to the vicinity of Ganado, Texas. At this elevation, it has an active conservation capacity of 157,884 acre-feet, providing a dependable annual water supply of 75,000 acre-feet.

The spillway is 464 feet wide and has twelve 35-foot-wide by 22.61-foot-high radial gates. The spillway can discharge up to 190,000 ft^3/s of water. A 5-foot-wide by 7-foot-high service gallery runs through the gate structure crest section.

The dual-level M&I outlet works structures are located on each side of the spillway and will deliver water for future requirements. They include an intake structure with two 48- by 60-inch gates, conduit, and a terminal structure.

The river outlet works consists of a multilevel intake structure with one 96- by 96-inch gate and two 48- by 48-inch gates, an 8- by 8-foot upstream conduit, a gate structure with a 96- by 96-inch gate, an 8- by 10-foot downstream conduit, and a stilling basin. The intake structure and gate structure are connected with a prestressed, precast concrete access footbridge.

Open drains were constructed along the downstream toes of the dikes and the dam to intercept flows from natural drainage.

Ten boat-launching ramps are spaced around the 125-mile shoreline of Lake Texana to provide access for water recreationists. The Lavaca-Navidad River Authority operates Palmetto Bend Project including the Brackenridge Plantation Campground on the west side of Lake Texana near the site of the marina. One hundred pads are available for recreational vehicles at Brackenridge; 81 sites have full hookups and 19 have electricity and water available. There is a nature trail for hikers in the Mustang Creek area where an abundance of wildlife may be seen. The Texas Parks and Wildlife Department operates the Lake Texana State Recreation Area on 600 acres of land on the west side of the lake where facilities are available for camping, picnicking, and other activities. The recreation areas may be reached from U.S. Highway 59, traveling southeast from Edna on State Highway 111 or south from Ganado on State Highway 172. Farm-to-Market Road 3131 has been extended from FM 1593 to FM 1822 over the crest of the dam.

The climate of the Texas Coastal Plains area is mild and humid with erratic precipitation, hot summers, and mild winters. Spring brings a spectacular array of wildflowers, but the other seasons are just as colorful with the thick carpet of rice fields and the luxurious growth of live oak, pecan, hackberry, rose hedge, and yew. Wildlife - from armadillo and deer to ducks and geese - can be sighted in the area; and, although there are few, the threatened American alligator is known to inhabit streams and marshes in the Palmetto Bend Project area.

Lake Texana is named for the once-thriving, now extinct port of Texana founded along the Navidad River in 1834. The town died quickly when a railroad line was laid through Edna 7 miles to the north, bypassing Texana. Most of the inhabitants of Texana left, and the county seat was subsequently moved to Edna. An archeological exhibit and artifacts from the ghost town are on display at the headquarters of the Lavaca-Navidad River Authority just west of Palmetto Bend Dam.

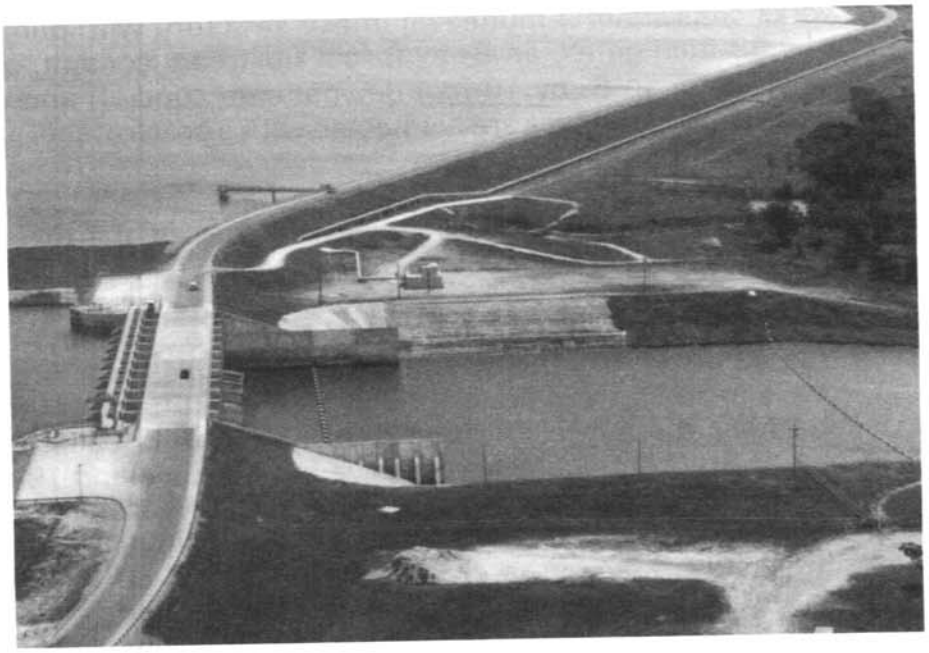


Photo 1. - Palmetto Bend Dam, Texas. Aerial view of spillway. 9/86

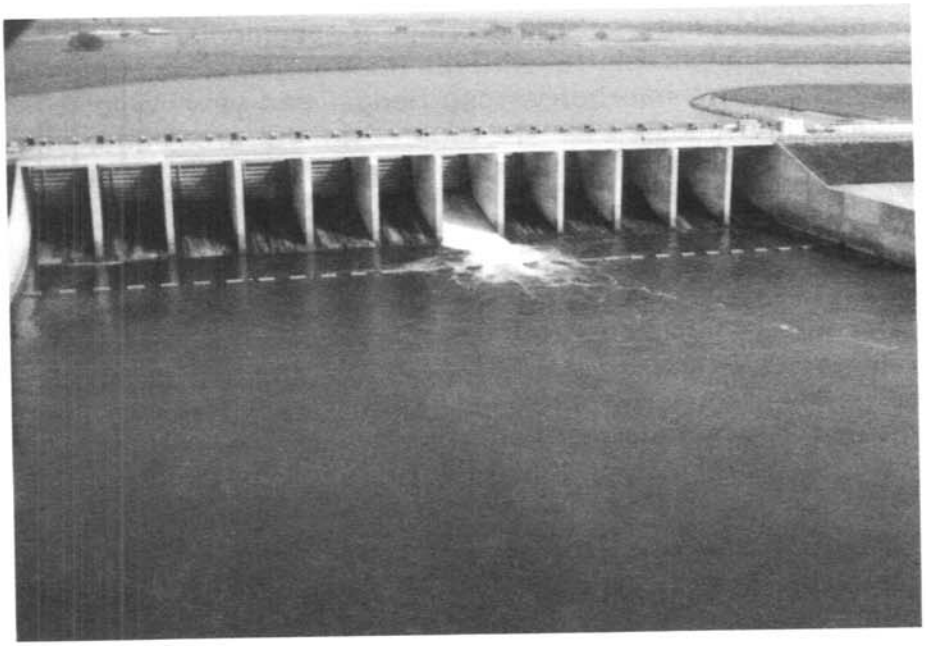


Photo 2. - Palmetto Bend Dam, Texas. Aerial view of the spillway during the "emergency release" order by the Texas Water Commissioner. 9/7/84

Photo 3. - Palmetto Bend Dam, Texas. Aerial view of spillway, river outlet works, pipeline, and east and west parking lots. 9/86

Photo 4. - Palmetto Bend Dam, Texas. Aerial view of Dam and Lake Texana. 5/12/84

Photo 5. - Palmetto Bend Dam, Texas. Aerial view of the Brackenridge Plantation Campground shoreline. Lake level is 43.16. 9/7/84

Photo 6. - Palmetto Bend Dam, Texas. Aerial view of the marina. 9/7/84

CASE STUDY

CURRANT CREEK DAM - FLOODING OF CONTROL HOUSE

Project:	Central Utah
State:	Utah
Type:	Zoned earthfill
Completed:	1977
Function(s):	Irrigation
Crest length:	1,600 feet
Hydraulic height:	132 feet
Active capacity:	1,120 acre-feet
Surface area:	286 acres

Design Characteristics: The principal features of Currant Creek Dam include a zoned earthfill embankment, a spillway, and an outlet works. The outlet works consists of an inlet structure and a 12-foot-diameter steel-lined conduit with an access shaft which leads to a 9- by 12-foot emergency gate. Immediately downstream from the emergency gate, the conduit separates into a 16-foot 9-inch horseshoe section.

A 12-inch filling/bypass pipe is used to fill the outlet pipe and for making low-discharge deliveries. The bypass pipe extends from a nozzle upstream of the 9- by 12-foot outlet gate down the invert of the 16-foot 9-inch horseshoe-shaped tunnel to the control structure where it is connected to the 20-inch pipe with a sleeve-type dresser coupling.

Evidence: The first evidence of the failure was the discovery that the emergency generator was running. Then, about 10 feet of water in the outlet works control house was discovered.

Incident: On April 6, 1985, the downstream section of the 12-inch filling/bypass pipe at Currant Creek Dam separated from the 20-inch bypass pipeline at the entrance of the gate chamber access tunnel and flooded the outlet works control house.

Causes: The cause of the failure was lack of sufficient thrust protection at the sleeve-type dresser coupling where a 12-inch bypass line connects to the 20-inch bypass line. The force due to internal pressure had overcome the friction force of the coupling causing it to separate.

Remedy: The following corrective measures were recommended following the incident:

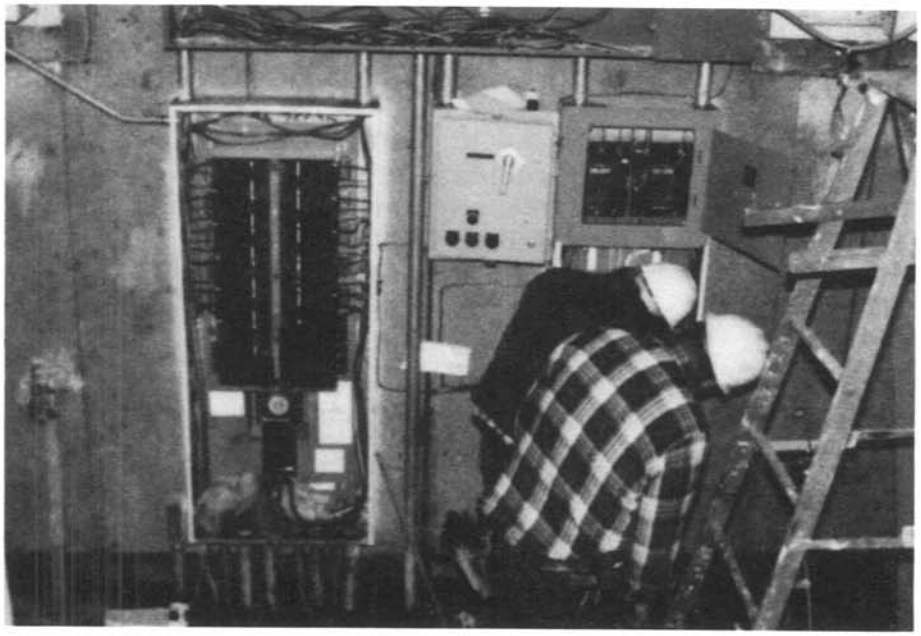
a. Replace the sleeve-type couplings on the 12-inch filling/bypass line with class E flanged joints.

b. Replace all electrical controls, switches, circuit breakers, and contacts as required to return the system to an operable condition.

c. Replace damaged sections of ventilation ductwork.

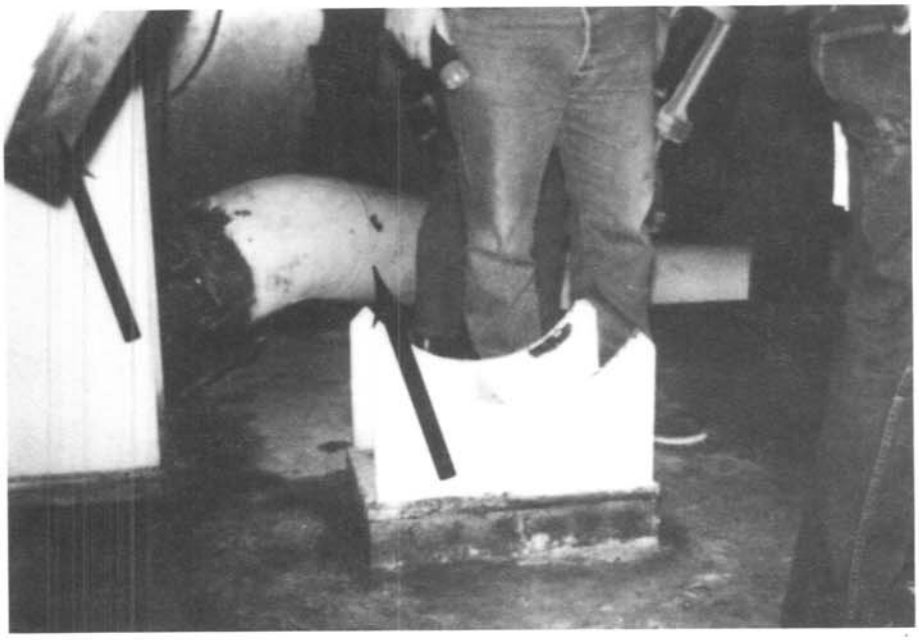
d. Relocate the emergency generator transfer switch from the access tunnel to the generator house. This will assure emergency power for operation of the 9- by 12-foot emergency high-pressure gate upon loss of normal power.

e. Install a float-operated alarm in the control house as part of the supervisory control system. The alarm will alert operation personnel to any future flooding.



Currant Creek Dam. - Electrical equipment in the control house was essentially destroyed by flooding. 4/9/85

Currant Creek Dam. - Class E-type flange which replaced sleeve-type couplings. 4/9/85



Currant Creek Dam. - Separation of coupling flooded entire outlet-works access shaft. Twelve-inch filling/bypass pipe that blew apart is in background. 4/9/85

Currant Creek Dam. - Example of dresser-style coupling unsupported for thrust load. 4/9/85

GPO 857-485

Mission of the Bureau of Reclamation

The Bureau of Reclamation of the U.S. Department of the Interior is responsible for the development and conservation of the Nation's water resources in the Western United States.

The Bureau's original purpose "to provide for the reclamation of arid and semiarid lands in the West" today covers a wide range of interrelated functions. These include providing municipal and industrial water supplies; hydroelectric power generation; irrigation water for agriculture; water quality improvement; flood control; river navigation; river regulation and control; fish and wildlife enhancement; outdoor recreation; and research on water-related design, construction, materials, atmospheric management, and wind and solar power.

Bureau programs most frequently are the result of close cooperation with the U.S. Congress, other Federal agencies, States, local governments, academic institutions, water-user organizations, and other concerned groups.

Bulletins are available for a small charge, depending on size ($0.30 to $5.10), from the Bureau of Reclamation, Attn D-7923A, PO Box 25007, Denver CO 80225. (Bulletins prior to No. 83 are available only on microfiche.)